

NOTES ON THE BIOLOGY AND IMMATURE STAGES OF
POECILOGRAPHA DECORA (LOEW)
(DIPTERA: SCIOMYZIDAE)

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Abstract.—The puparium and third-instar cephalopharyngeal skeleton of the enigmatic sciomyzid fly, *Poecilographa decora* (Loew), are described, and the distribution is mapped. Notes on life history are presented, as well as ecological and taxonomic predictions based upon morphology of the immature stages.

Key Words: Diptera, Sciomyzidae, *Poecilographa*, immature stages

While working as a consultant entomologist with the Arctic Health Research Center of the U.S. Public Health Service at Anchorage, Alaska, during the summers of 1950-1952, the late Professor Clifford O. Berg discovered that larvae of Sciomyzidae prey upon mollusks. Following that discovery, his own research and that of many students and associates turned mainly to the careful elucidation of life histories of the sciomyzids of the world. About one third of the approximately 600 described species in this cosmopolitan family have been reared, and the larvae of all are obligate predators or parasitoids of various mollusks. Most species feed on freshwater or terrestrial, nonoperculate snails, but some attack snail eggs, operculate snails, salt marsh snails, slugs, or sphaeriid clams. Berg and Knutson (1978) reviewed the biology and systematics of the Sciomyzidae.

Nearly all students of Nearctic Sciomyzidae have attempted to rear the striking and distinctive species, *Poecilographa decora* (Loew), the sole member of its genus. However, no researcher has ever reared it through the entire life cycle, and the literature on this species is largely restricted to

basic taxonomy and Johannsen's (1935) brief description of a puparium. My recent discovery of three puparia in the field has prompted the writing of this paper, which I hope will stimulate renewed interest in elucidating the life history of this mysterious species.

BIOLOGY

Puparia were collected at Black Creek Swamp, on Koontz Rd., Voorheesville, New York (42°39'57"N, 73°58'05"W). They were found among moist litter under a thin canopy of *Ulmus rubra* Muhlenberg and *Fraxinus pennsylvanica* Marshall in an un-flooded area where adults had been collected previously. The dominant low vegetation is *Aster simplex* Willdenow and *Onoclea sensibilis* Linnacus. The locality is frequently flooded during the spring and after heavy rains, and it is surrounded by a creek and a *Typha* and *Sparganium* marsh.

A puparium collected June 2, 1983, yielded an adult female on June 15, and one collected on June 16, 1983, yielded a female on June 27. The third puparium, collected June 30, 1983, yielded no adult and upon close inspection was found to have a 0.7

mm diameter circular hole in the integument, probably an emergence hole of a parasitoid. The single puparium that Johannsen (1935) reported upon "... was found in a bog in woods near Ithaca, New York, on June 2" (p. 48), and it yielded an adult on June 17. Johannsen's puparium is not in the Cornell University Insect Collection with the adult it yielded, and it probably has been lost. The others are deposited in the New York State Museum.

On July 6, 1981, one male and three female *P. decora* adults were collected at Black Creek Swamp and placed in a 5.0 × 8.5 cm clear plastic vial fitted with a screen cap and containing a layer of moist cotton, forest litter, a resting stick, and an artificial diet for the adults consisting of honey, brewer's yeast, and dehydrated milk. They were held in an incubator at 20°C under a LD 16:8 lighting schedule. They mated and laid eggs readily and frequently. The eggs, which are creamy white, 0.83–0.91 mm long, and striate, were placed in scattered, unorganized groups, usually along the edge of a piece of drying litter in the bottom of the vial. On July 15, the eggs laid over the previous nine days were harvested from the breeding vial, and it was found that none had hatched. The eggs were placed on moist cotton, and four of them hatched on July 29. These four had been kept especially moist—so that the chorion actually appeared wet; others had dried somewhat from evaporation. The larvae were placed in a dish of water, but no matter how carefully they were manipulated, it was impossible to make them float, even though microscopic examination reveals that they possess short, interspiracular, hairlike processes or "float hairs." Other researchers have found that first-instar larvae of *P. decora* float readily, with the posterior end at the surface film (B. A. Foote, pers. comm.).

The eggs laid July 15–31 were submerged in water for about 2 hours on July 31. None had hatched up to that date, but by August 3, 15 had hatched; by August 6, 10 more;

by August 10, 36 more; and by August 19, the remaining 16 had hatched. Very few more eggs were laid, and all adults soon died.

Attempts were made to rear first-instar larvae on various gastropods, including *Gyraulus* sp. (Planorbidae), *Lymnaea* sp. (Lymnaeidae), *Oxyloma* sp. (Succineidae), and an unidentified land snail (Discidae: *Discus* sp.?), collected at Black Creek Swamp. No feeding was observed, and all larvae perished. Failure also resulted from attempts to rear first-instar larvae on living *Biomphalaria glabrata* (Say) and *Helisoma trivolvis* (Say) (Planorbidae); living and freshly killed *Deroceras laeve* (Müller) (Limacidae); living *Haplotrema concavum* (Say) (Haplotrematidae); living *Lymnaea palustris* (Müller) [= *Stagnicola elodes* (Say)]; living *Oxyloma decampi* (Tryson) [= *O. retusa* (L. Lea)] and eggs of *Oxyloma* sp.; living *Physella gyrina* (Say) (Physidae); juveniles and eggs of *Stenotrema hirsutum* (Say) (Polygyridae); and living and dead *Ventridens demissus* (Binney), and living *Zonitoides arboreus* (Say) and *Z. nitidus* (Müller) (Zonitidae) (B. A. Foote, pers. comm.).

Records of 210 adult male and 254 adult female museum specimens reveal that *P. decora* has a distribution typical of many nearctic sciomyzids. Specimens have been collected from central Saskatchewan east to New Brunswick, south to Virginia, and west to Colorado (Fig. 1). Adults are first seen in late May, they peak in numbers in July, and specimens are rarely taken after mid August, although one male from Dickinson County, Michigan, was collected on September 22, 1982. Therefore, it seems likely the species is univoltine.

DESCRIPTION

Puparium (Fig. 2): Length, 4.8–5.4 mm; greatest width, 1.7–2.0 mm; greatest height, 1.7–1.9 mm. Unicolorous reddish brown, but segments 2–4 and 12 somewhat darker than remainder. Integument opaque, with finely pebbled sculpturing, especially dor-

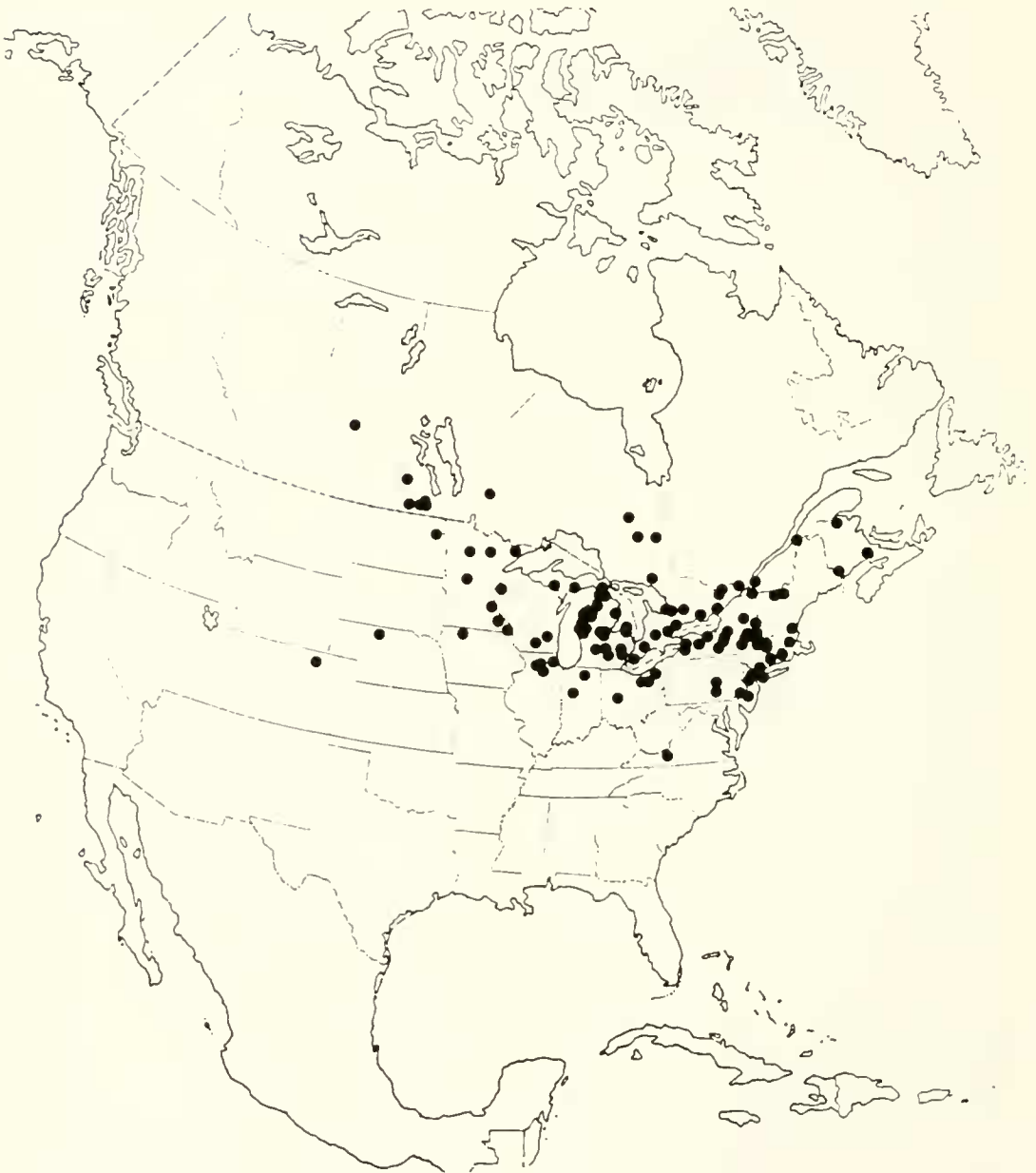
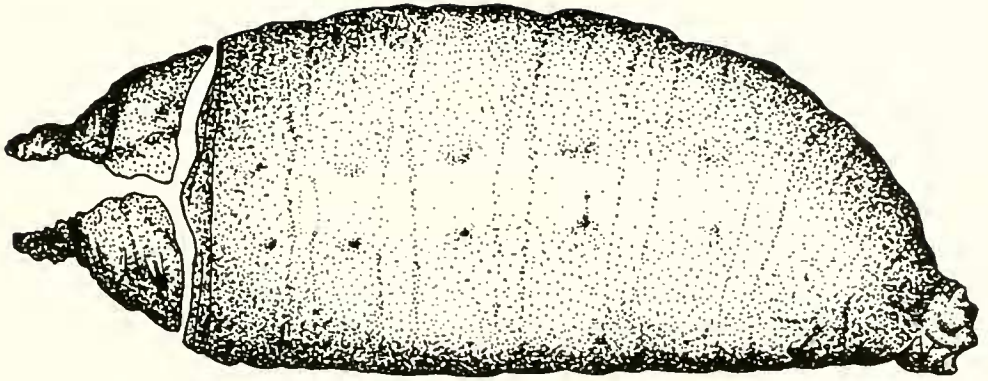


Fig. 1. Collecting sites for *Poecilographa decora*.

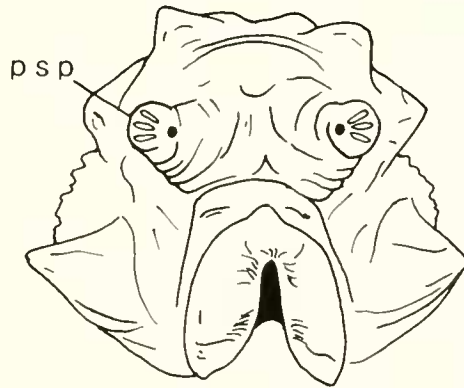
sally and laterally; densely wrinkled on segments 2–4 and 12. Puparium elongate, subcylindrical, dorsally convex and ventrally nearly straight in profile. Primary and secondary integumentary folds faint; 2 secondary folds dorsally, 3 ventrally. Segment 1 invaginated. Segments 2–4 strongly tapered

anteriorly. First 2 apparent segments (segments 2 and 3) dorsoventrally flattened, not upturned, distinctly narrower than succeeding segments. Anterior spiracles projecting from anterolateral angles of segment 2, dark brown, subcircular, bearing about 8 distinct, marginal papillae. Distinct tubercles



1.0 mm

2

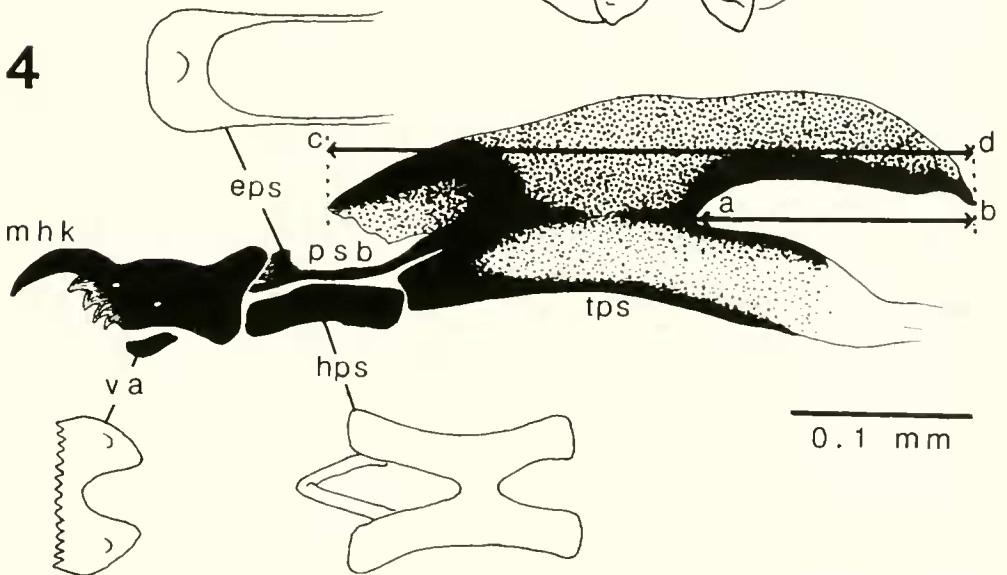


psp

3

0.2 mm

4



eps

c

d

mhk

psb

tps

va

hps

0.1 mm

Figs. 2-4. *Poecilographa decora*. 2, Puparium, cephalic caps separated. 3, Posterior spiracular disc; psp = posterior spiracle. 4, Cephalopharyngeal skeleton; eps = epipharyngeal sclerite; hps = hypopharyngeal sclerite; mhk = mouthhook; psb = parastomal bar; tps = tentoropharyngeal sclerite; va = ventral arch; ab/cd = indentation index.

and creeping welts absent from segments 2–11. Segments 11 and 12 tapered posteriorly. Segment 12 distinctly ventral in position, not upturned, truncate, with mid-dorsal indentation. Anus invaginated.

Posterior spiracular disc (Fig. 3) strongly indented posteroventrally, bearing 4 pairs of short, wrinkled lobes (indistinguishable in 1 specimen) and 2 dorsomedial spiracular plates. Dorsolateral and lateral lobes shortest, about as long as diameter of spiracular plates; ventrolateral and ventral lobes longer, 0.35–0.40 mm. Spiracular plates subcircular, at apices of 2 dark brown to black spiracular tubes; tubes shorter than diameter of plates, longer on lateral surface than on mesial; each spiracular plate with 3 elongate-oval, diverging, yellow spiracular slits and a mesial, subcircular, black spiracular scar; plates lacking well-developed, interspiracular, hairlike processes (float hairs).

Cephalopharyngeal skeleton (Fig. 4) brown, 0.53 mm long; indentation index (ab/cd) 44. Paired mandibles not fused, with decurved mouthhooks; 4–5 decurved, lightly pigmented accessory teeth anteroventrally; and 2 small windows posterior to accessory teeth. Ventral arch convex below, with 14 small teeth on anterior margin, deeply emarginate posteromesially. Epipharyngeal sclerite fused to anterior ends of parastomal bars. Posterior ends of parastomal bars fused to tentoropharyngeal sclerites. Hypopharyngeal sclerite H-shaped, not fused to mandibles or tentoropharyngeal sclerites; anterior emargination about $1.5 \times$ length of posterior emargination. Ligulate sclerite anterior to hypopharyngeal sclerite, small, V-shaped. Paired tentoropharyngeal sclerites not fused, lacking dorsal bridge and fenestrations; ventral cornua distinctly shorter than dorsal cornua.

DISCUSSION

Data from this preliminary study indicate that *Poecilographa decora* is a typical member of the subfamily Sciomyzinae, tribe Tetanocerini, and that the third-instar larva

and puparium are terrestrial. Morphological characteristics that support placement of this species in the Tetanocerini include the striate egg chorion, lack of well-developed ventral spinule patches on the larval integument, presence of accessory teeth on the mandibles, lack of a dorsal bridge between the tentoropharyngeal sclerites, lack of a window in the dorsal cornu, lack of tentoropharyngeal-hypopharyngeal fusion, and a third-instar indentation index of less than 50. The facts that this species can pupate and oviposit in the absence of a host also support placement in the Tetanocerini. Knutson (1966), Knutson et al. (1970), and Boyes et al. (1969, 1972) provide good summaries of morphological and behavioral differences between the Tetanocerini and Sciomyzini.

The lack of well-developed interspiracular float hairs on the puparium, the fact that the posterior end is not upturned (thus not allowing the spiracles to contact atmospheric air if the puparium were floating), and the microhabitat of the puparia discussed here indicate that the immature stages of *P. decora* are terrestrial. However, most reared species of Tetanocerini are aquatic predators; their larvae live in water, floating just beneath the surface film, and they attack snails effectively there as well as on moist shores or floating vegetation. All reared species of Sciomyzini are parasitoids in terrestrial or semi-aquatic situations, but this type of feeding behavior is also seen in a few species of Tetanocerini and the only reared species of Salticellinae. The tetanocerine terrestrial parasitoids are usually host specific at the species, genus or family level. As they mature, the larvae become quick-killing predators and eventually leave the shell of their last victim to pupate in soil or litter. A few Tetanocerini feed on decaying snails as well as fresh prey (Berg and Knutson, 1978). These observations suggest handling methods and potential hosts to be used in future attempts to rear *Poecilographa decora*.

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LITERATURE CITED

- Berg, C. O. and L. Knutson. 1978. Biology and systematics of the Sciomyzidae. *Ann. Rev. Entomol.* 23: 239-258.
- Boyes, J. W., L. V. Knutson, K. Y. Jan, and C. O. Berg. 1969. Cytotaxonomic studies of Sciomyzidae (Diptera: Acalyptratae). *Trans. Amer. Microsc. Soc.* 88: 331-356.
- Boyes, J. W., L. V. Knutson, and J. M. van Brink. 1972. Further cytotaxonomic studies of *Sciomyzidae*, with description of a new species, *Dichetophora boyesi* Steyskal (Diptera: Acalyptratae). *Genetica* 43: 334-365.
- Johannsen, O. A. 1935. Aquatic Diptera. Part II. Orthorrhapha—Brachycera and Cyclorrhapha. *Cornell Univ. Agric. Exp. Sta. Mem.* 177. 62 pp.
- Knutson, L. V. 1966. Biology and immature stages of malacophagous flies: *Antichaeta analis*, *A. atriseta*, *A. brevipennis*, and *A. obliuosa*. *Trans. Amer. Entomol. Soc.* 92: 67-101.
- Knutson, L. V., J. W. Stephenson, and C. O. Berg. 1970. Biosystematic studies of *Salticella fasciata* (Meigen), a snail-killing fly (Diptera: Sciomyzidae). *Trans. Roy. Entomol. Soc. Lond.* 122: 81-100.